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Louisiana Coastal Protection and Restoration

ENCLOSURE I

Fish and Wildlife Service Planning Aid Report

Preliminary Technical Report to Congress

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Louisiana Coastal Protection and Restoration
Preliminary Technical Report to Congress

Plan Formulation
Planning Aid Report

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INTRODUCTION

As directed by Congress through the Department of Defense Appropriations Act, 2006 (P.L. 109-148), and P.L. 109-103, as amended, the U.S. Army Corps of Engineers (Corps) has initiated work on the Category 5 Louisiana Hurricane Protection and Restoration (LACPR) Project to "conduct a comprehensive hurricane protection analysis and design . . . to develop and present a full range of flood control, coastal restoration, and hurricane protection measures exclusive of normal policy considerations for South Louisiana." The purpose of this report is to provide U.S. Fish and Wildlife Service (Service) plan formulation-related comments and recommendations regarding proposed levee alignments, preferred coastal wetland restoration strategies, and specific restoration measures. Given the very short completion schedule mandated by Congress, the Service offers the following comments as planning-aid information for inclusion in the Corps' Preliminary Technical Report, and to assist in future, more-detailed planning. Accordingly, this report is provided in accordance with the Fish and Wildlife Coordination Act (FWCA, 48 Stat. 401, as amended; 16 U.S.C. 661 et seq.), and the Migratory Bird Treaty Act (40 Stat. 755, as amended; 16 U.S.C. 703 et seq.), but it does not constitute the report of the Secretary of the Interior as required by Section 2(b) of the Fish and Wildlife Coordination Act. Our National Environmental Policy Act (NEPA) scoping-level comments were provided by letter dated April 4, 2006, and are incorporated by reference herein. Initial Endangered Species Act (ESA) of 1973 (87 Stat. 884, as amended; 16 U.S.C. 1531 et seq.) information was also provided in those scoping-level comments to assist the Corps in fulfilling their proactive consultation responsibilities under the ESA.

Because the LACPR is being conducted outside of normal planning policies and under a very short schedule, this document differs in both format and content from our usual planning-aid report format. All graphic information cited in the text has been appended at the end of this report. In order to make clear key concepts, planning constraints, and recommendations, this report is organized to first present a discussion of fish and wildlife resource conditions and concerns. That section outlines over-arching issues and planning constraints that support and provide context for the basin-specific sections that follow. Each of those sections, in turn, provide more detailed information pertaining to initial levee alignment concerns and recommendations, an overview of general wetland restoration concepts and features, and specific initial restoration concerns and recommendations. Our summary comments are provided to encapsulate key planning goals and objectives that should be adopted to ensure that fish and wildlife resources, including the ecosystems upon which they depend, are considered equally with the development-related study goals and objectives.

FISH AND WILDLIFE RESOURCE CONDITIONS AND CONCERNS

The proposed project area encompasses all of the coastal Louisiana ecosystem as well as portions of the lower Mississippi River and Gulf of Mexico ecosystems. Under existing and future without LACPR conditions, the environmental, social, and economic values associated with each of those systems can be expected to continue to decline, as detailed below. The LACPR project area is dominated by coastal wetlands including forested wetlands (bottomland hardwoods and swamps), coastal marshes (fresh, intermediate, brackish, and saline) and associated shallow,

open waters. Those habitats provide important escape, feeding, breeding/spawning, brood rearing/nursery, and wintering sites for a wide variety of aquatic, estuarine and wetland-dependent fish and wildlife (e.g., migratory waterfowl, wading birds, shorebirds, seabirds, other waterbirds, neotropical migratory songbirds, threatened and endangered species, and interjurisdictional fisheries) for which the Service has Federal-trust conservation responsibilities.

Due to a variety of causative factors, Louisiana continues to lose approximately 24 square miles of its coastal wetlands each year (U.S. Army Corps of Engineers 2004). Those losses impact not only the region's nationally significant fish and wildlife resources, but also the commercial and recreational industries that they support. The loss of those wetlands and their storm surge buffering capacity is resulting in a continual increase in storm surge heights that increasingly threaten our coastal communities, nationally significant oil and gas production facilities, and related infrastructure. In addition to the obvious economic and ecological impacts associated with coastal wetland loss, continued losses of the storm buffering capacity afforded by those wetlands and associated natural features, in combination with existing and projected sea level rise and subsidence rates, will result in ever-escalating costs to maintain community and infrastructure protection, and in increased storm-related risks, including loss of life. Accordingly, ensuring the long-term sustainability of significant portions of the coastal ecosystem, as well as the infrastructure and habitats it supports, should be adopted as an over-arching planning goal (especially within the Deltaic Plain) of the LACPR.

This situation is largely (but not solely) the result of human interruptions of the natural processes which built and sustained the Louisiana coastal wetland ecosystem. The foremost such disruption was the construction of levees along the Mississippi River which disconnected the river's alluvial processes from the adjacent coastal ecosystem, isolated it from its floodplain, and short-circuited its connection with the Gulf of Mexico. Decades of such management have facilitated the drainage and conversion of the once vast and highly productive bottomland hardwood forested wetlands of the Mississippi River Alluvial Valley (MAV) ecosystem to highly intensive agricultural production, much of which has proven to be unsustainable. While the decline of the MAV ecosystem has been well-documented by the Service and others, it is also important to recognize that the Gulf of Mexico ecosystem has also been seriously affected, as evidenced by the annual 4.5-million acre hypoxic zone off-shore of the Louisiana coast.

We are concerned that the proposed LACPR hurricane protection levee system may result in further landscape-level disconnections and process interruptions which will accelerate, perhaps irreversibly, the collapse of Louisiana's coastal ecosystem. Under the present conditions, therefore, we do not believe that long-term hurricane protection can be safely, effectively, or economically implemented or maintained unless the current coastal wetland ecosystem loss rate is concurrently reversed. Over the long-term, sustainable ecosystem protection must be delivered by restoring natural processes, at both landscape and smaller scales, to the maximum extent practicable. This issue has become critical within portions of the rapidly eroding and subsiding Deltaic Plain. Although Chenier Plain marshes have experienced significant past losses, those wetlands are much more stable at present. Accordingly, and in light of the unparalleled social, economic, and ecological consequences of the 2005 hurricanes, the majority of initial LACPR planning and design efforts should focus on providing balanced structural and

non-structural hurricane protection and sustainable ecosystem-level restoration within the Deltaic Plain and the Mississippi River.

Given the effects of subsidence and sea level rise, large-scale sediment and freshwater input is essential for continued survival and long-term sustainability of the coastal ecosystem and the human uses that it supports. Consequently, the sediment load carried by the Mississippi and Atchafalaya Rivers, already greatly reduced by past water development projects in those systems, is an extremely valuable and needed commodity that can no longer be deliberately lost to the deep waters of the Gulf of Mexico. Management of the Mississippi River and its tributaries must necessarily be modified to maintain and/or increase sediment delivery to Louisiana's coastal ecosystem. Within that coastal ecosystem itself, those rivers must be intensively managed to capture and efficiently distribute as much of their now invaluable sediment load as possible. Such management modifications will require an immediate and fundamental change in past strategies, practices, and budgets.

For example, sedimentation within those rivers was viewed as an expensive hindrance to navigation and extensive modifications were made to the river morphology to preclude shoaling. Rather than continue deliberately losing that sediment to the Gulf, however, a new management strategy must continue to provide for navigation and commerce, while simultaneously including both the discharge of that sediment load into coastal wetlands through diversions, and inducing the remainder to settle out in sediment traps so that it can be used to rebuild coastal marshes, ridges, barrier islands, and other land forms that are essential to provide the key outer-most lines of defense against destructive storm surges. To achieve this management strategy, diversions and spillways should be designed, constructed, and operated to cumulatively divert all, or nearly all, of the seasonal high-river flows into the coastal wetlands so that critically needed sediments are no longer lost directly to the Gulf of Mexico. Controlled diversions should also be adaptively managed to include pulsing or other means of operation to maximize sediment introduction when high riverine sediment concentrations are available. During periods of low river flows, when suspended sediment concentrations are often low, little or no diversion of riverine sediments would occur; however, freshwater diversions within selected upstream areas may continue during those low-flow periods. Such a management change would also facilitate nutrient uptake within coastal basins that would help reduce Gulf of Mexico hypoxia.

As mentioned above, the Service believes that the levee alignments and proposed coastal wetland restoration features selected for implementation should be highly complimentary, and that such restoration features should also be selected for their capacity to restore a self-sustaining coastal ecosystem to the greatest degree possible. Large and small diversions from the river would help to achieve a sustainable coastal ecosystem over the long-term, but may not provide immediate storm surge protection because their benefits would accrue relatively slowly over time. Hence, short-term protection may have to be provided through the direct construction of features that mimic natural landscape components that have been/are being lost. If properly designed and operated, however, diversions in concert with other restored natural features, would provide both short-term and sustainable long-term ecosystem restoration and storm surge protection benefits. Such an approach should also substantially reduce project maintenance costs than would otherwise be the case in the currently collapsing Deltaic Plain portion of the coastal ecosystem.

Recognizing that impacts to fish and wildlife resources are but one of many issues which must be considered when designing a potentially expansive system of high-level hurricane protection levees, the Service is charged, on behalf of the Department of the Interior, to identify and recommend measures to ensure the nation's fish and wildlife resources are considered equally with other project goals and objectives. Given that the study completion schedule is a significant legislatively imposed constraint to effective large-scale planning and design, and because "conflicting stakeholder interests represent one of the greatest barricades to robust coastal restoration efforts in Louisiana" (NRC 2006), delivering sustainable category 5 hurricane/storm surge flood protection simultaneously with large-scale ecosystem restoration will be essential to achieve the public interest, both nationally and locally. To be cost-effective, such an approach must also acknowledge that specific portions of the coast likely cannot be sustained under the future without, and future with the LACPR. The extent to which current ecosystem losses can be halted or reduced will precisely determine those areas that can be sustainably protected from storm-related damages, and that should targeted for sustainable landscape-level restoration. While we recognize that the hurricanes of 2005 were the largest natural disaster in the nation's history, it is critical to learn from those events. Despite their tragic effects, those storms have provided a once-in-a-lifetime opportunity to strategically reconnect the ecosystem-level processes needed to sustainably restore the lower Mississippi River, coastal Louisiana, and the Gulf of Mexico ecosystems.

Avoidance of LACPR-related wetland impacts during levee construction and indirect project-related hydrologic disruptions should be adopted as primary plan formulation and evaluation constraints. Coupled with non-structural measures to reduce damage-susceptible uses, such impacts could be avoided or reduced by constructing an alternative alignment consisting of a series of ring levees around highly populated areas and key infrastructure that can realistically be sustained. Such an alternative may be less costly than a continuous levee system, and because of its compartmentalized nature, may also reduce the risk of catastrophic storm surge damages that can be expected if a breach occurs in the continuous barrier levee across the coastal zone. Consequently, the Service requests that the Corps fully consider implementing a system of ring-levees in lieu of a continuous levee within those portions of coastal Louisiana where high-density human population and infrastructure can be sustained. That approach should also include fair and sensitive relocations, buy-outs, and elevation of structures in rural areas to provide cost-effective non-structural protection and/or risk reduction. Those non-structural protection measures should be included as integral components of project alternatives and the selected plan.

The alternatives considered to date consist primarily of continuous levee alignments. The Service recommends that regardless of their type, location or size, protection levees should be constructed on non-wetlands rather than on wetlands to the maximum extent feasible. Siting levees on non-wetlands would increase their potential capacity to protect and sustain highly populated areas, and reduce construction and long-term maintenance costs owing to higher quality foundation soils and the opportunity to provide critical vegetated wetlands to protect levees.

Given the potential scope of levee construction under this project, all advanced engineering, design and construction plans should spatially identify proposed borrow material locations, quantities needed/available, and the associated costs. Associated borrow impacts should also be

evaluated. Such planning should also include any borrow material required for post-construction levee maintenance. Where possible, the Corps should consider obtaining borrow material in a manner that would facilitate construction of freshwater/sediment conveyance channels to achieve both sustainable wetland restoration in concert with construction of hurricane protection features. Additionally, all maintenance dredged material should be used beneficially to create marshes or appropriately stock-piled for future levee construction and for restoration activities.

Given the potential landscape-scale scope of the proposed LACPR project, construction plans should also include a proposed construction schedule. That schedule should include an estimate of the time required to complete construction to final levee grade. Such a schedule will be necessary to disclose potential storm-related risks to area residents and landowners, and to estimate the pace of construction-related wetland impacts and mitigation requirements, if needed.

Because hydrology and wetland restoration needs vary throughout coastal Louisiana, the Service is pleased to offer the following initial comments and recommendations by coastal basin. Because of the compressed study schedule, and the directive to proceed exclusive of normal policy considerations, there has been little guidance on the degree of wetland restoration needed or desired. Accordingly, the restoration recommendations provided in the following sections can be scaled upward or downward to provide greater or lesser benefits. Our recommendations are preliminary, and do not exhaust the full range of options available within each respective basin. At a minimum, therefore, the project-related wetland restoration features should fully compensate for direct and indirect project-related wetland impacts. If the results of planned hydrodynamic modeling of all affected areas will not become available until after the final Technical Report to Congress and Draft Programmatic Environmental Impact Statement are published, then the risks and uncertainities associated with direct, indirect, and cumulative effects LACPR impact- and benefit-assessments will likely be significant. We strongly advocate that the associated wetland restoration features be selected on the basis of their capability to restore ecosystem sustainability to the greatest degree possible.

LAKE PONTCHARTRAIN BASIN

Pontchartrain Basin – Initial Levee Recommendations

The proposed enclosure of Lake Pontchartrain could impact the drainage of excess precipitation, restrict operation of the Bonnet Carre Spillway, and reduce ingress and egress of estuarine-dependent fishes and shellfishes. Construction of a storm surge barrier across the Lake Borgne landbridge would also result in substantial construction-related marsh losses. Based on the experience of storm-related debris obstructing such structures, the threat of impaired post-storm drainage must also be taken into account. A possible alternative to avoid those enclosure-related adverse impacts would consist of a multiple lines of defense approach, coupled with improving existing levees around New Orleans, constructing the proposed West Shore Lake Pontchartrain features, and constructing new lake-front levees for Slidell and other communities along the north shore of Lake Pontchartrain (Figure 1). A major levee around eastern New Orleans could be afforded greater protection from open waters of Lake Borgne if it were located along or west of the existing Maxent Canal levee rather than along the existing outermost levee. Such new levees should be constructed on non-wetlands to the greatest degree possible.

If that alternative is not as feasible, or would result in greater construction-related wetland losses than the proposed Barrier Plan levee across the Lake Borgne landbridge, the proposed barrier plan structures in the Rigolettes and Chef Menteur Passes should be sized to avoid any reduction in the existing cross-sections of those passes. Restoration and protection of natural protection features, located primarily in the Biloxi marshes, should also be included in that plan to provide additional seaward defenses.

To reduce construction-related wetland impacts in the Lake Borgne area, the protection levee should be located on the north bank of the Gulf Intracoastal Waterway (GIWW) and on Mississippi River Gulf Outlet (MRGO) spoil banks. This approach would require only one major structure in the GIWW rather than two (i.e., in the GIWW and MRGO). Compared to locating the levee along the western shore of Lake Borgne, the marshes seaward of the Service's alternative would help protect that levee and would reduce direct exposure of that levee to surge and waves in Lake Borgne.

The proposed construction of the protection levee up the western edge of the Pearl River basin would likely result in intercepted drainage and ponding of excess water within enclosed bottomland hardwoods. Those indirect adverse impacts could be avoided by constructing an interior collection canal emptying into the Fritchie Marsh. Although the Fritchie marshes could potentially benefit from the resulting additional freshwater inputs, northward saltwater intrusion into enclosed cypress swamps and bottomland hardwoods would have to be avoided. Those issues cannot be addressed or resolved until a detailed levee route is identified.

Pontchartrain Basin – Overview of Wetland Restoration Concepts/Features

Of the natural features surrounding New Orleans, the Biloxi marshes may provide the most important storm-surge reduction benefits to that city. Because of their seaward and exposed location, however, the Biloxi marshes would likely be the most difficult wetlands within the Pontchartrain Basin to sustain. Loss of those marshes appears to be primarily due to wind-wave erosion. Consequently, the protection of the Biloxi marshes should be achieved through construction of protective wave breaks, segmented oyster reefs, or other features (Figure 2). In addition to protecting existing marshes, re-construction of historic ridges and marsh areas would also help to restore the barrier functions that the Biloxi Marshes once provided.

Long-term marsh vigor and nourishment for those marshes should also be provided by implementing strategic Mississippi River diversions. Enlargement of the existing Violet Siphon and/or diversions through the Inner Harbor Navigation Canal Locks would help achieve this goal, provided that the MRGO is closed or significantly constricted. Otherwise, the opportunistic use of the Bonnet Carre Spillway could potentially help achieve this need. Diversion-related algal blooms in Lake Pontchartrain could be reduced or avoided if that spillway is modified to reduce channelized flows and increase overland flows. If diversions would maintain suitable salinity ranges in the outer Biloxi marshes for optimal oyster production, then efforts to protect that area could be enhanced by establishing segmented oyster reefs around the Biloxi marsh complex. Specific restoration measures listed below are identified as either providing immediate storm surge protection benefits (I), or long-term, sustainable protection (S).

Pontchartrain Basin – Initial Specific Wetland Restoration Recommendations

1. Create/nourish marsh along the southeastern fringe of the Lake Borgne landbridge to restore and maintain its integrity. Construct erosion protection features and conduct periodic marsh creation/nourishment where and as needed. (I)
2. Create an elevated and armored rim along the western shore of Lake Borne to prevent future shoreline erosion and reduce inland propagation of storm surges and waves into that area. That feature would consist of a higher forested lake rim sloping downward to a broad interior marsh platform. (I)
3. Elevate and widen the intact portion of the Bayou LaLoutre ridge, rebuild the largely eroded northeasternmost portion and reforest it. Rebuilt portions of the ridge would include broad marsh aprons on either side. (I)
4. Rebuild the eroding Biloxi marsh rim along the south shore of Mississippi Sound. (I)
5. Protect existing and restored features within the Biloxi marshes by constructing erosion protection features around the exposed perimeter of that marsh complex. (I)
6. Close and restore the Mississippi River Gulf Outlet to protect and sustain natural protection features, and rebuild such features where necessary. (S)
7. Nourish and sustain Biloxi marshes and Lake Borgne landbridge marshes with seasonal introductions of Mississippi River water by enlarging the existing Violet Siphon or by diverting water through the Inner Harbor Navigation Canal Locks. This goal could be achieved provided that the MRGO is closed or significantly constricted. Otherwise, the opportunistic use of the Bonnet Carre Spillway may help achieve this need. (S)
8. Create marsh in interior open water areas and install shore protection features on the north shore of Lake Pontchartrain, between Mandeville and Slidell. (I)
9. Construct two 5,000 cfs diversions into the Maurepas swamps to enhance their sustainability and prevent their conversion to open water. Conversion of those swamps to open water would increase the flooding threat to nearby communities during storm events due to the wind-driven tides across Lakes Pontchartrain, Maurepas, and adjoining open water areas. (S)
10. Extend the proposed protection levee no further northward up the Pearl River Basin than needed. The levee should be located on non-wetlands, and the two connections between the Fritchie Marsh and the Pearl River system (Salt Bayou and a site northwest of White Kitchen) should be maintained/improved.
11. Rebuild the Chandaleur Islands if it can be demonstrated that they would provide a significant level of storm surge reduction. (I)

BRETON SOUND BASIN

Breton Sound Basin – Initial Levee Recommendations

If the existing back protection levees are raised, the levee footprint should be expanded inland to avoid wetland impacts. South of Betrandville, no back protection levee presently exists. The Service recommends that State Highway 39 be elevated across this area so that the river levee can be modified to create an overflow spillway there. South of this area, that highway is located adjacent to a separate back protection levee. Consequently, it would be impractical to raise those back levees without expanding the footprint into the seaward marshes. To avoid those adverse wetland impacts, increased storm surge protection in that area should be provided in a manner that avoids such impacts; otherwise those levees should not be raised. Additionally, the Service

recommends that three to four small spillways, roughly 1,300 to 3,000 feet wide, should also be constructed through the protected corridor to segment it into smaller units for added flood protection, and to rebuild and improve the sustainability of adjoining marshes and the protection they afford to the existing levee.

Breton Sound Basin – Overview of Wetland Restoration Concepts/Features

The Service recommends the construction and operation of Mississippi River diversions and overflow spillways to rebuild and nourish marsh sufficient to achieve long-term net wetland gains and provide storm surge buffering (Figure 3). Spillway elevations should be capable of conveying river water during all but low water periods. More immediate storm surge protection should be provided by constructing a band of marsh across the mouth of the basin at the heads of the bays. That band should also include an elevated bay rim and armoring or other means of erosion protection as warranted by site-specific conditions. Construction and operation of a major land-building diversion at American Bay would deposit sediments in local lakes and bays that would be reworked on to the bay-edge marshes, thereby reducing wind-wave related erosion, and providing long-term protection of marshes in the southern portion of the basin. Along the Mississippi River below Pointe-a-la-Hache, a series of revetment and bank notches should be constructed to allow sediment inputs to sustain and increase the adjacent wetlands and offset erosion-related wetland losses of those marshes exposed to Breton Sound and other large open water bodies. Specific restoration measures listed below are identified as either providing immediate storm surge protection benefits (I), or long-term, sustainable protection (S).

Breton Sound Basin – Initial Specific Wetland Restoration Recommendations

1. Construct a major land-building diversion at American Bay. Adaptively manage the outfall area to maximize deltaic land-building. (S)
2. Construct a sediment diversion (e.g., (15,000 to 20,000 cfs) at White's Ditch to build and nourish existing marshes in the southwest and central portions of the basin. Adaptively manage the outfall area to maximize distribution of introduced water and suspended sediment. (S)
3. Where no back protection levee exists below Bertrandville, degrade the existing Mississippi River levee crest sufficiently to create a spillway. If needed, maximum crest elevations within that spillway should be lowered and appropriately armored to facilitate annual discharges during all but low water periods to sustain basin wetlands and repair Hurricane Katrina-related wetland impacts. (S)
4. Operate the Caernarvon Diversion to maximize land-building and wetland maintenance processes. (S)
5. Direct Caernarvon Diversion flows eastward into the subbasin north of the Bayou Terre aux Boeufs ridge by constructing a continuous borrow canal (associated with levee construction) along the foot of the existing protection levee from Caernarvon to and across the Bayou Terre aux Boeufs ridge. (S)
6. Increase Caernarvon Diversion flows southwestward by enlarging an existing canal on the southwest corner of the Big Mar. (S)
7. Construct 3 or 4 small Mississippi River spillways (approximately 1,300 to 3,000 feet wide) through the protected corridor between Carlisle and Bohemia to nourish existing marsh and rebuild eroded marshes. If needed, maximum crest elevations within those spillways should be lowered and armored as needed to facilitate annual overflow during all but low river stages.

Adaptively manage the outfall areas to maximize distribution of introduced water and suspended sediment. (S)
8. Remove the gates from the existing Bayou Lamoque diversion structures to facilitate year-round water flow at that location. (S)
9. South of Bohemia, construct a series of bank and revetment notches along the Mississippi River to increase the flow of river water and suspended sediment into adjoining marshes. (S)
8. At the heads of the major bays and lakes, construct a band of marsh across the basin from roughly Pointe-a-la-Hache northeastward to the MRGO spoil bank. That marsh band would include an elevated bay rim and armoring where needed to prevent erosion losses. This feature would provide immediate storm surge buffering and would accelerate land-building associated with upper-basin diversion features. (I)
9. Repair hurricane-damaged marsh in the center of the basin by constructing a marsh land bridge across the center of the damaged area. (I)
10. Rebuild the Chandaleur Islands if it can be demonstrated that they would provide a significant level of storm surge reduction. (I)

MISSISSIPPI RIVER DELTA BASIN

Category 5 hurricane protection levees are not proposed in this area. Depending on the efficiency of upstream sediment capture and removal, the sediment supply to area marshes may be reduced in the future. Given that subsidence rates in this basin exceed 3.5 feet per century (Louisiana Coastal Wetlands Conservation and Restoration Task Force and the Wetlands Conservation and Restoration Authority 1998), use of sediments elsewhere would be a more efficient and sustainable use of that valuable but limited resource. Existing basin marshes should, in that case, be managed via a defensive or managed retreat approach. Adaptive management through crevasse construction and maintenance should be implemented where most efficient. Dredged material should be beneficially used within this basin unless more critical ecosystem-level needs exist elsewhere.

BARATARIA BASIN

<u>Barataria Basin – Initial Levee Recommendations</u>
Three major alternative levee alignments across the Barataria Basin are being considered and modeled. The GIWW alignment would cross the basin on the south GIWW spoil bank. The Highway 90 alignment would cross the basin parallel to and south of U.S. Highway 90. The Bayou Lafourche Ridge (or swamp) alignment would avoid crossing the basin by constructing protection levees up the flanks of the basin on either side as far as necessary to provide hurricane surge/flood protection. While that latter alternative may provide the greatest ecosystem benefits over the long term, other structural features such as ring levees, may be required to protect the upper basin communities of Chackbay, Kraemer, and Lower Vacherie. Sensitive and equitable relocations, buy-outs, and elevation of structures should also be considered for such interior communities.

The Service recommends that construction of any new levees or upgrading of existing levees be accomplished in a manner that avoids construction-related wetland impacts. If that could be accomplished, then the Service's alignment preference would by default be based strictly on fish and wildlife impacts associated with indirect hydrologic impacts. Because the swamp alignment would avoid such indirect impacts and would facilitate needed riverine diversions into the swamps of the upper basin, it would most effectively restore sustainability of those swamps over the long term.

The GIWW alignment would be the Service's least preferred alignment, since it would result in the greatest potential hydrologic impacts and restrict operation of the Davis Pond Freshwater Diversion Project and/or other diversions needed to help achieve sustainability of upper Basin swamps. The proposed GIWW levee alignment may also have greater wetland impacts than the other alignments because there are few existing levees and non-wetland areas on which to locate that levee. Because the GIWW alignment would also enclose more wetlands than the other two alignments, it may pose the greatest risk for induced development within the impounded wetland/high-risk coastal areas in the upper basin.

The Highway 90 alignment would have limited hydrologic impacts, because Bayou Des Allemands currently provides the only water exchange point along that route. Should that alignment be considered, the Service recommends that the Bayou Des Allemands floodgate be sized to avoid any constriction of the channel cross section, and that consideration be given to increasing the cross section to allow operation of upper basin freshwater diversion projects. That additional drainage capacity might be provided by construction of two structures, one on Bayou Gauche, and the other on Bayou Des Allemands. The Highway 90 alignment might also obviate the need for levee upgrades, ring levees, and other measures to protect interior basin communities up-basin of U.S. Highway 90. The Highway 90 alignment would also add permanence to existing high-risk developments and would likely be used in the future as justification to support additional unsustainable development at the expense of basin wetlands.

The "pipeline canal" modification on the southwestern terminus of the Highway 90 alignment would intercept drainage of a small interdistributary basin south of Gheens and would likely result in increased construction-related wetland losses. Hence, the Service would not support that modification of the Highway 90 alignment.

Barataria Basin – Overview of Wetland Restoration Concepts/Features

Some of the highest wetland loss rates in coastal Louisiana occur within the lower and middle Barataria Basin. Without sustainable wetland restoration, hurricane protection measures will be severely compromised in their ability to protect populated areas from storm surge to any degree of sustainability. The restoration of self-sustaining wetlands and other natural features would compliment hurricane protection features by providing outer lines of defense, and would potentially reduce long-term operation and maintenance costs of protection features. Wetland restoration features for the Barataria Basin should therefore focus on multiple lines of sustainable natural defense. Those restoration features should include barrier island/headland restoration, rebuilding of natural ridges, marsh creation/nourishment along bay shorelines and in other strategic locations, shoreline protection in critical areas, and river re-introductions to build wetlands and maintain existing marshes and swamps (Figure 4).

Wetlands flanking the lower Barataria Basin have deteriorated considerably such that future hurricane protection measures in those areas will be seriously compromised if restoration features are not implemented to provide natural protection as a first line of defense. Barrier island restoration, river re-introductions, natural ridge restoration, and marsh creation should form the basis of ecosystem restoration within the lower basin. Barrier island restoration would improve suspended sediment retention/deposition associated with proposed river diversion features, thereby improving the land-building efficiency of those features.

Continued wetland deterioration in the middle Barataria Basin will over time, allow storm surges to penetrate farther inland. The primary restoration strategies for the middle basin consist of marsh creation and shoreline protection in critical areas for immediate buffering and protection. Long-term protection and sustainability would be achieved through construction and operation of appropriately sized river re-introductions. The cypress-tupelo swamps of the upper basin provide effective storm surge reduction and wind buffering benefits, however, those swamps are subsiding. Those habitats, which are not presently sustainable, should be managed through the construction and operation of two or more diversion features to provide sediments and nutrients needed to achieve sustainably offset subsidence. Specific restoration measures listed below are identified as either providing immediate storm surge protection benefits (I), or long-term, sustainable protection (S).

Lower Barataria Basin – Initial Specific Wetland Restoration Recommendations

1. Create and maintain beaches, dunes, and marshes along the Caminada headland. Specifically, features being evaluated under the LCA Barrier Shoreline Feasibility Study should be implemented. (I)
2. Maintain beaches and dunes on Grand Isle. (I)
3. Create and maintain beaches, dunes, and marshes on West Grand Terre. Dredged material from maintenance of the lower Barataria Bay Waterway should continue to be used to restore/maintain this island. (I)
4. Create and maintain beaches, dunes, and marshes on East Grand Terre. Specifically, the East Grand Terre Island Restoration Project funded by CWPPRA should be implemented and maintained over the project life. (I)
5. Create and maintain beach, dunes, and marsh from Point Cheniere Ronquille eastward to Sandy Point. Several sections of this reach are being addressed by CWPPRA projects and the LCA Barrier Shoreline Feasibility Study. CWPPRA projects either under construction or in engineering and design include the Pass La Mer to Pass Chaland Restoration, Pass Chaland to Grand Bayou Pass Barrier Shoreline Restoration, Pelican Island Restoration, and Scofield Island Restoration Projects. The LCA Barrier Shoreline Feasibility Study is evaluating alternatives for the Shell Island area. Each of those projects or selected alternatives under the LCA study, should be implemented and maintained over the project life. Sections of this reach not addressed by the above projects should also be restored and maintained. (I)
6. Restore the Bayou Lafourche ridge (south of Golden Meadow to Port Fourchon), Bayou L'Ours ridge, Bayou Grande Cheniere ridge, Bayou Long-Bayou Fontanelle ridge (Empire Waterway), and Bayou Grand Liard ridge. Restoration would include increasing ridge elevation and width with dredged material. Those restored ridges would provide much improved tidal surge buffering and wave energy reduction than are presently provided. Some of those ridges

would also serve as outfall management features that would improve the effectiveness of proposed river diversion features. (I)
7. Create a band of marsh along the fringe of Caminada Bay, beginning west of Caminada Pass and continuing eastward around Barataria Bay, ending north of Adams Bay near Empire. The seaward edge of that marsh band would require erosion protection with either rock armoring, sand placement, or reef construction. This marsh band would protect inland marshes from erosion, help to retain introduced freshwater, and would serve as a second line of defense behind the barrier islands to reduce storm surge and wave energy. (I)
8. Create a second band of marsh between Little Lake and Barataria Bay to prevent Little Lake from increasing in size. This band of marsh would help maintain the separation between Little Lake and Barataria Bay, and would help protect a portion of the marsh band described above under recommendation 7. (I)
9. Create marsh in critical areas within the Lake Hermitage basin to protect existing and proposed hurricane protection levees. The area between the Mississippi River and the Bayou Grande Cheniere ridge has deteriorated significantly, such that very little wetland buffer currently exists along the river. The Lake Hermitage Marsh Creation Project, recently approved for engineering and design under CWPPRA, should be implemented. (I)
10. Construct a diversion into Yellow Cotton Bay (near Fort Jackson or Boothville) to rebuild marshes between the Mississippi River and the Gulf shoreline. The Grand Liard ridge should also be restored to retain fresh water and sediments within this system. Marshes in this area would also protect existing and/or future hurricane protection features west of the Mississippi River. (S)
11. Construct a diversion near Buras to rebuild marshes between the Mississippi River and the Gulf shoreline. The Grand Liard ridge to the east and the Bayou Long-Bayou Fontanelle ridge to the west should be restored to retain fresh water and sediments within this system. Marshes in this area would protect existing and/or future hurricane protection features west of the Mississippi River. (S)
12. Construct a diversion near Homeplace to nourish existing marshes between the Mississippi River and the Gulf shoreline. This diversion could be smaller than those proposed downstream at Buras and Fort Jackson, because the need to build land is not as critical in this area. This diversion would be sized to nourish existing marsh and the marsh band created along the northern bay fringe as described above under recommendation 7. (S)
13. Increase the operation and/or flow capacity of the West Pointe a la Hache siphons to nourish existing and created marshes in that area. Restoration of the Bayou Grande Cheniere ridge would retain fresh water and sediments within this system. (S)
14. Create a band of marsh from roughly Lake Grand Ecaille to Bastian Bay. (I)

<u>Middle Barataria Basin</u>
1. Create/nourish marshes between Little Lake-Turtle Bay and Bayous Perot and Rigolettes. This landmass separating Little Lake from Bayous Perot and Rigolettes has been identified as a critical buffer between the low-energy fresh water systems to the north and the moderate-energy brackish and saline marshes to the south. The Dedicated Dredging on the Barataria Basin Landbridge Project, funded under CWPPRA, should be implemented as the first step of this feature. (I)
2. Protect eroding shorelines around Bayous Perot and Rigolettes. Interagency planning efforts identified this area as critical to maintaining the integrity of the Barataria Basin Landbridge. The

majority of this area is being addressed by various phases of the Barataria Landbridge Shoreline Protection and the Jonathan Davis Wetland Restoration Projects funded under CWPPRA. Unconstructed phases of those projects should be implemented and maintained throughout the life of the LACPR. (I)
3. Restore elevation and width of the Bayou Barataria ridge south of the Dupre Cut. Restoration of this ridge could serve as a wave buffer and as an outfall management feature for the proposed Myrtle Grove Diversion Project. (I)
4. Restore elevation and width of the Cheniere Traverse Bayou ridge. Restoration of this ridge could serve as a wave buffer to surrounding marshes, reduce storm surges moving up the eastern side of the basin, and help protect the communities of Lafitte and Barataria. (I)
5. Construct a sediment diversion (e.g., 15,000 to 20,000 cfs) near Myrtle Grove to rebuild marsh and nourish existing marsh between the Mississippi River and Barataria Bay. The area south of Myrtle Grove down to Round Lake and Lake Laurier has deteriorated significantly and very little wetland buffer remains to protect existing and proposed hurricane protection features in this area. The diversion should be sized to move significant amounts of sediment into this region to rebuild eroded wetlands and maintain existing marshes. (S)
6. Create a band of marsh between Bayou Dupont and the existing flood protection levees. The Bayou Dupont Sediment Delivery System Project funded by CWPPRA should be implemented as the first step in restoring wetlands in this area. (I)
7. Increase the operation and/or flow capacity of the Naomi siphon to nourish marshes in the area. Marshes in this area have not deteriorated significantly but should be sustained to continue providing a buffer for the existing and proposed hurricane protection levees. (S)
8. Modify the operation of the Davis Pond Freshwater Diversion Project to maximize wetland sustainability. (S)

Upper Barataria Basin
1. Construct and operate appropriately-sized diversions to enhance and sustain cypress-tupelo swamps. A first step in this strategy should be implementation of the Small Freshwater Diversion into the Northwestern Barataria Basin Project funded under CWPPRA. Other diversion projects should be implemented to sustain swamps throughout the upper basin. (S)

TERREBONNE BASIN

Terrebonne Basin – Initial Levee Recommendations
Potential levee alignments across the Terrebonne Basin include the Louisiana State University (LSU) alternative and the selected alternative described in the Morganza to the Gulf of Mexico Project's Programmatic Environmental Impact Statement. Based upon the initial information available for these alternatives, we believe that the LSU alternative may result in substantially less direct wetland impact than would the Morganza alternative, and would reduce the potential for inducing additional high-risk development along the southern extent of the affected ridges.

If the LSU alternative were constructed by creating a continuous borrow canal that would connect with the GIWW on either end (i.e., like a Houma bypass channel), and if it is appropriately sized and smaller distribution channels are enlarged, that borrow channel would create a very efficient and effective means of increasing Atchafalaya River freshwater flows to

portions of central and eastern Terrebonne Basin (Figure 5). On the other hand, the Houma Navigation Canal (HNC) Lock complex of the proposed Morganza alternative could stop northward saltwater intrusion up the HNC, and might if appropriately designed and operated, improve distribution of Atchafalaya River freshwater to wetland areas east and west of the HNC.

The potential freshwater distribution opportunities associated with the LSU alternative would achieve some of those that are possible under the Morganza alternative, and would likely exceed them in eastern portions of the Terrebonne Basin. Given that current modeling projections of the HNC Lock complex show that its ability to improve freshwater distribution is questionable, and because the LSU alternative would result in substantially less wetland impacts, the Service believes it would be the least damaging and most conducive to ecosystem sustainability, provided an appropriately sized bypass channel is created south of Houma. With the limited information at hand, the LSU alignment would provide the greatest opportunity for large-scale wetland sustainability in the areas of critical wetland loss south of Houma.

Both the LSU and the Morganza levee alternatives include the Barrier Plan identified under the Lower Atchafalaya Basin Re-Evaluation Study. The Barrier Plan would relieve backwater flooding of the Verret Subbasin through the installation of a large water control structure and pump station on Bayou Boeuf to prevent backwater flooding and maintain drainage during periods of high Atchafalaya River stages. Presently, the forested wetlands in the southern Verret Subbasin are not sustainable because of continually increasing water levels and isolation from sediment inputs by the East Atchafalaya Basin Guide Levee. The ideal solution to the sustainability of the Verret Subbasin's forested wetlands would have been to include this area within the Atchafalaya Basin Floodway and facilitate sediment and freshwater flow-through by constructing one or more outlets to the southeast through the Bayou Black ridge.

To achieve sustainability of Verret swamps and avoid enclosure-related fish and wildlife impacts of the Barrier Plan, the LSU alternative should be modified to extend the protection levee northward up the west flank of the Little Bayou Black ridge. Such an alternative would avoid enclosure-related wetland impacts within the Verret Subbasin and would facilitate construction of one or more diversions of Atchafalaya River water and sediment into the Verret Subbasin. Such actions would require that interior communities be protected from flooding by constructing ring levees, elevating structures, relocations, and/or buy-outs. Consistent with previous recommendations, associated levees should be constructed on non-wetlands for long-term sustainability, lower maintenance costs, and reduced wetland impacts.

If this alternative to the Barrier Plan is not practical or feasible, potential adverse impacts to the area's blue crab fishery and other fish and wildlife resources associated with the Barrier Plan should be avoided or reduced by minimizing closure of the Bayou Boeuf control structure. Basin water levels should not be drastically reduced and water levels should be managed to mimic, on a smaller scale, the natural fluctuations typical of the Atchafalaya River (i.e., spring high water, late summer and fall low water). Such management would also facilitate production of crawfish, thereby benefiting fish and wildlife resources that prey on them. Additionally, such water level fluctuations may help improve circulation and reduce water quality degradation that occurs with stable water level management.

Terrebonne Basin – Overview of Wetland Restoration Concepts/Features

Central and eastern Terrebonne Basin marshes will be the most difficult area in which to achieve wetland sustainability because of their high loss rates, advanced stage of deterioration, and isolation from potential riverine inputs. However, construction of a modified Third Delta-like diversion feature into the Wonder Lake area would likely achieve and exceed that goal by maintaining the existing marsh and creating a substantial acreage of new marsh over the long-term (Figure 6). The Third Delta-like feature would also facilitate freshwater and sediment introductions into the upper Barataria Basin swamps and its construction could also create needed protection levees within a portion of that basin.

To provide more immediate hurricane protection and enhance the effectiveness of the modified Third Delta-like feature, the creation of an outer protective band of marsh would also be required. The Third Delta-like project feature would require maintenance, but by using natural energies and processes to achieve its goals, its benefited area would be relatively self-sustaining. If the GIWW could be used to distribute introduced freshwater to adjoining subbasins, then the sustainability of those adjoining areas would also be improved. Without a project feature of this type, a larger portion of central and eastern Terrebonne marshes would likely not be self-sustaining, and greater volumes of mechanical sediment addition to compensate for the long-term effects of subsidence would be required. Failing that, area communities will likely face the increasing risk of repeated storm-related damage and substantial costs for maintaining protection levees.

A less effective and complex alternative to the modified Third Delta feature would consist of a combination of features that would increase the introduction and distribution of Atchafalaya River freshwater into portions of central and eastern Terrebonne Basin. The Avoca Island Extension Levee could be breached to increase freshwater flows into the GIWW, and smaller channels could be constructed/enlarged to move that water from the GIWW to areas of need (Figure 7). However, the breaching of the Avoca Island Extension Levee could not be accomplished until the Barrier Plan or other protection features have been constructed to protect low-lying communities near Amelia and in the Verret Basin from riverine backwater flooding. The Avoca feature, combined with the construction of the Houma bypass channel (and associated smaller distribution channels) would provide substantial opportunities to move fresh water into central and eastern Terrebonne. Because those features would not introduce a substantial quantity of suspended sediments, they would not likely sustain the southernmost marshes. Hence, long-term existence of those marshes may require periodic re-nourishment through hydraulic sediment additions to compensate for subsidence. Installation of other protection or restoration features would also be required to halt erosion of wetlands along the northern bay fringes and along the shores of larger inland lakes (Figure 8).

During high Atchafalaya River stages, the GIWW may carry as much as 12,000 cubic feet per second into Houma (Swarzenski 2003). East of the HNC, the cross-section of that channel is considerably reduced and includes an inefficient northward bend. Due to this and other factors, only 20 to 30 percent of the freshwater flows entering Houma via the GIWW continue eastward past the HNC. Construction of a Houma bypass channel would provide a straighter, larger and more efficient channel to move fresh water east of the HNC. Because it would be located further

south than the existing GIWW, it would also provide opportunities to introduce flows directly into Bayou Chauvin, Bayou Petit Caillou, and Bayou Terrebonne. Specific restoration measures listed below are identified as either providing immediate storm surge protection benefits (I), or long-term, sustainable protection (S).

Terrebonne Basin – Initial Specific Wetland Restoration Recommendations

1. Construct a modified Third Delta-like diversion into Wonder Lake. Construction of this feature would eliminate or reduce the need for the recommendation 2. (S)
2. Connect Bayou Shaffer with the Avoca Island Cutoff Channel near the mouth of Bayou Penchant, or, direct all or part of Bayou Shaffer flows into Avoca Island. The Barrier Plan, or other means of protecting low-lying and flood prone areas within the Verret Subbasin would have to be completed as a prerequisite to avoid project-induced flooding. (S)
3. Extend Carencro Bayou southward from Bayou Penchant to Little Carencro Bayou to maintain tidal marshes that buffer floating marshes to the north from marine influences. The enlargement of Minor's Canal may provide an alternative to this feature. The long-term effectiveness of this alternative would be improved by the restoration and maintenance of the Small Bayou la Pointe ridge. (S)
4. Construct a water conveyance channel south of Houma to improve eastward GIWW freshwater flows to central and eastern Terrebonne. (S)
5. Improve distribution of GIWW freshwater by extending Bayou Chauvin northward to the new bypass channel, and enlarging portions of Grand Bayou. If the Houma bypass channel is not constructed, then those features would still be needed to improve distribution of existing GIWW freshwater inputs. However, freshwater inputs to the northern Lake Boudreaux Basin should be sought instead through the construction of the CWPPRA program's North Lake Boudreaux Basin Freshwater Introduction Project. (S)
6. Construct and operate the HNC Lock complex to halt saltwater intrusion up the HNC and to improve the distribution of freshwater flows into marshes adjoining the HNC. (S)
7. Construct a band of marsh along the northern fringe of Lake Pelto, Terrebonne Bay, and Timbalier Bay. The southern edge of that marsh band would require erosion protection through rock armoring, sand placement, or reef construction. This marsh band would protect more inland marshes from erosion and would help to retain introduced freshwater and sediments. (I)
8. Elevate and widen subsided ridges (i.e., Marmande/Mauvois Bois, Small Bayou la Pointe, Bayou Dularge, Bayou Terrebonne, and Bayou Pointe au Chene. (I)
9. Create inland bands of marsh to reduce fetch across eroding marsh areas that are in danger of enlarging to become major lakes. Areas where such marsh bands would be constructed include the Bayou Rambio area between Bayou DuLarge and Grand Caillou, between Lakes Boudreaux and Quitman, and across the Timbalier Subbasin marshes along the "twin pipelines." (I)
10. Strategically create marsh in other open water areas south of Falgout Canal, Sweetwater Pond and adjoining open water areas between the HNC and Highway 57. (I)
11. Protect the eroding Gulf of Mexico shoreline south of Sister Lake to prevent increased tidal exchange between that lake and the Gulf. Some recently formed tidal exchange sites should also be closed. (S)
12. Rebuild the western spit of Pointe au Fer Island and restore the barrier reef, from the western tip of the island to Eugene Island. This would improve growth of the Atchafalaya River Delta and sediment introduction/retention within interior area of Pointe au Fer and other western

Terrebonne Basin marshes. This feature is also recommended under the Atchafalaya Basin section of this report. (S)
13. Restore and maintain eroded portions of the Isles Derneries, the Timbalier Islands, and the Casse Tete/Brush Island complex. (I)
14. Introduce fresh water and suspended sediment into the Verret Subbasin to improve sustainability of degraded swamps. Alternatively, sustainability of those swamps might be achieved through thin-layer sediment addition through hydraulic pumping. (I)

ATCHAFALAYA BASIN

Atchafalaya Basin – Initial Levee Recommendations

To reduce construction-related wetland impacts, and potential impacts to Bayou Teche National Wildlife Refuge and occupied habitat of the threatened Louisiana Black Bear, the Service recommends that west of the Wax Lake Outlet (WLO), the proposed levee be located south of the Southern Pacific Railroad paralleling U.S. Highway 90. However, west of Bayou Sale, we recommend that the levee location transition to non-wetlands paralleling and several hundred feet inland of the wetland/non-wetland interface. The non-wetland area seaward of the levee should be planted in suitable tree species to provide protection for the levee. If forested areas already exist seaward of the levee route, they should be left intact and preserved to provide immediate protection for the newly constructed levee.

Atchafalaya Basin – Overview of Wetland Restoration Concepts/Features

The Service's recommendations in this area consist of features that would enhance delta-building processes in Atchafalaya Bay to create additional wetland acreage (Figure 9). Because those wetlands are seaward of existing communities, they would provide greater storm surge protection than the existing marsh and open bay conditions. Specific restoration measures listed below are identified as either providing immediate storm surge protection benefits (I), or long-term, sustainable protection (S).

Atchafalaya Basin – Initial Specific Wetland Restoration Recommendations

1. Reconstruct a reef-like structure along the footprint of the old barrier reef between Pointe au Fer Island and Eugene Island. This structure should duplicate, to the greatest degree practical, the hydrologic function of the former barrier reef, and need not be a living oyster reef. The reef-like structure should be segmented to maintain navigation between the Gulf and Atchafalaya Bay. Such a reef would increase deltaic land-building within eastern Atchafalaya Bay and would improve the sustainability of existing marshes on Pointe au Fer Island and in the western Terrebonne Basin. (S)
2. Accelerate delta-building in the WLO Delta by extending the WLO channel northward, through Cypress Island to the Atchafalaya River, in a manner that maximizes the sediment load entering the WLO. Because deltaic processes in the Wax Lake Outlet Delta have not been compromised by a navigation channel as they have been in the Lower Atchafalaya River Delta, the sediments carried by the Wax Lake Outlet would be more effectively retained to produce marshes than if those sediments were carried down the Lower Atchafalaya River to its delta. (S)
3. Consider relocating the existing navigation channel through Shell Island Pass and Atchafalaya Bay between the two deltas to minimize channel-related impacts to delta-building processes.

This concept assumes that the entrance to Shell Island Pass can be modified to leave the majority of suspended sediment in the river, thereby restoring efficient natural deltaic processes in the Lower Atchafalaya River Delta. (S)

TECHE/VERMILION BASIN

Teche/Vermilion Basin – Initial Levee Recommendations

To avoid and/or minimize potential direct and indirect wetland impacts associated with construction of a continuous levee across this basin, a ring levee approach should be evaluated for protecting larger communities. That approach should include non-structural means for cost-effective risk reduction in areas outside of proposed protection levees. To reduce construction-related wetland impacts, the Service recommends that proposed levees be located on non-wetlands paralleling and several hundred feet inland of the wetland/non-wetland interface. The non-wetland area seaward of the levee should be planted in appropriate tree species to provide protection for the levee. If forested areas already exist seaward of the levee route, they should be left intact and preserved to provide immediate protection for the newly constructed levee.

Teche/Vermilion Basin – Overview of Wetland Restoration Concepts/Features

Wetland losses in this basin are low and are caused primarily by shoreline erosion or small-scale and site-specific problems. Wetland restoration recommendations (Figure 10) are designed to address some of those problems; otherwise, area wetlands are thought to be generally self-sustaining due to increasing inputs of suspended sediments from the WLO and Atchafalaya River. Specific restoration measures listed below are identified as either providing immediate storm surge protection benefits (I), or long-term, sustainable protection (S).

Teche/Vermilion Basin – overview of wetland restoration efforts

1. Create/maintain marsh on Marsh Island and north of the bay complex, where marsh loss is occuring that will likely result in additional open water areas that would facilitate inland propagation of storm surges. (I)
2. Conduct vegetative plantings or install shoreline protection measures along rapidly eroding sections of bay shorelines. (S)
3. To prevent Southwest Pass from enlarging, armor the eroding banks of Southwest Point and Lighthouse Point. (S)
4. Certain marshes hydrologically connected to the GIWW have experienced shoaling of water bodies and land gains due to increased sedimentation. Deteriorated areas isolated from the GIWW should be adaptively managed to restore appropriate degrees of connection with the GIWW to improve their sustainability. (S)
5. Construct foreshore rip-rap dikes at the Vermilion Bay entrance to Four Mile Cut to reduce boat-wake erosion of marshes at the entrance to that channel. (I)

MERMENTAU BASIN

Mermentau Basin – Initial Levee Recommendations

To avoid and/or minimize potential direct and indirect wetland impacts associated with construction of a continuous levee across this basin, a ring levee approach should be evaluated for protecting larger communities. That approach should include non-structural means for cost-effective risk reduction in areas outside of proposed protection levees. To reduce construction-related wetland impacts and improve long-term sustainability, the Service recommends that the proposed levee be located on non-wetlands paralleling and several hundred feet inland of the wetland/non-wetland interface. The non-wetland area seaward of the levee should be planted in trees to help provide protection for the levee. If forested areas already exist seaward of the levee route, they should be left intact and preserved to provide immediate protection for the newly constructed levee.

Because many of the proposed restoration features are distant from the recommended levee, those features may not provide substantial protection to that levee beyond that already provided by the existing marshes. However, construction of those restoration features would improve and maintain greater storm surge protection for the smaller communities seaward of the recommended levees.

Mermentau Basin – Overview of Wetland Restoration Concepts/Features

In some areas on Rockefeller Refuge, Gulf of Mexico shoreline erosion exceeds 40 feet per year. There and elsewhere, continued Gulf shore erosion prevents formation of an elevated beach rim and may increase erosion of fragile interior marshes. Stabilization of those shorelines is therefore a major wetland restoration goal in this area. High water levels in the Lakes Subbasin following heavy rainfall events are also a regional problem which impact marsh health and cause accelerated erosion of the Grand and White Lakes shorelines. Thus, the sustainability of Mermentau Basin marshes would be improved if both Gulf shoreline protection and adequate drainage outlets are provided as features of the LACPR project (Figure 11). Specific restoration measures listed below are identified as either providing immediate storm surge protection benefits (I), or long-term, sustainable protection (S).

Mermentau Basin – Initial Specific Wetland Restoration Recommendations

1. Prevent continued erosion of the Gulf of Mexico shoreline (from the Dewitt Canal westward to Hackberry Beach) by placing dredged material near the existing Gulf shoreline to create a more gradual slope to reduce erosive wave energies. Material would be dredged from the near-shore Gulf, and would preferably be sand or sandy silts. Sediment placement would also help to re-create an elevated beach rim which would dampen inland propagation of storm surges and waves. Vegetative plantings should also be included to help retain sand and promote dune formation. (S)
2. Operate a sediment by-pass system at the Mermentau Ship Channel to reduce Gulf of Mexico shoreline erosion west of the jetties. (I)
3. When the Calcasieu Locks are replaced, utilize the old lock system to discharge excess water from the Lakes Subbasin following heavy rainfall events. (S)

4. Construct an additional large water discharge structure in the bypass channels of the Leland Bowman Locks and the Catfish Point and Schooner Bayou control structures to provide additional capacity to quickly relieve high water levels following heavy rainfall events. (S)
5. Introduce excess fresh water from the Lakes Subbasin into tidal marshes to the south wherever possible. (S)
6. Clean-out the filled-in portions of Hog Bayou so that it effectively drains the eastern portion of its watershed and to preclude further exchange of water directly with the Gulf through Beach Prong. Such a feature would also compliment efforts to introduce fresh water into the eastern end of that watershed. (S)
7. Create marsh in permanently flooded former impoundments in the eastern Hog Bayou watershed and in the area south of Pecan Island. Dredged material could potentially be obtained from Upper Mud Lake or the Gulf of Mexico. An alternative to marsh creation would involve constructing vegetated terraces in open water areas. (I)
8. Stop erosion of the southeast White Lake shoreline from Wills Point to the Old Intracoastal Waterway (approximately 6 miles). The stabilization method could be the same as the CWPPRA South White Lake Shoreline Stabilization project (i.e., a rock foreshore dike placed 50 to 100 feet lakeward, with 50-foot-wide gaps every 1,000 feet). (S)
9. Stop erosion of the southern, southeastern, and eastern shorelines of Grand Lake, from Tebo Point to the northern portion of Umbrella Bay (approximately 22 miles). This would incorporate the South Grand Lake Shoreline Protection CWPPRA Project that has been designed but has not received construction funding. (S)
10. Reforest cheniers to help dampen inland propagation of storm surges and waves. Cheniers dredged for shell should also be refilled and reforested whereever possible. (S)

CALCASIEU/SABINE BASIN

Calcasieu/Sabine Basin – Initial Levee Recommendations

To avoid and/or minimize potential direct and indirect wetland impacts associated with construction of a continuous levee across this basin, a ring levee approach should be evaluated for protecting larger communities. That approach should include non-structural means for cost-effective risk reduction in areas outside of proposed protection levees. To reduce wetland impacts, the Service recommends that the proposed levee be located on non-wetlands paralleling and several hundred feet inland of the wetland/non-wetland interface. The non-wetland area seaward of the levee should be planted in trees to provide protection for the levee. If forested areas already exist seaward of the levee route, they should be left intact and preserved to provide immediate protection for the newly constructed levee.

Because water exchange in this basin is generally eastward and westward from Calcasieu Lake, any north-south orientated levee alternatives would likely cause serious system-level disruptions of drainage and water exchange, and should generally be avoided.

Because many of the proposed restoration features are distant from proposed northerly levee alignments, those features may not provide substantial protection to that levee beyond that already provided by the existing marshes. However, construction of those restoration features

would improve storm surge protection for the smaller communities closer to the Gulf and would provide valuable fish and wildlife habitat benefits.

Calcasieu/Sabine Basin – Overview of Wetland Restoration Concepts/Features

Sustainability of basin marshes is most threatened by the continued erosion and retreat of the Gulf of Mexico shoreline. Catastrophic wetland losses associated with the dredging of deep-draft navigation channels and resultant saltwater intrusion have in some areas been stabilized and reduced through construction and operation of large water/marsh management projects on either side of Calcasieu Lake. To maintain and sustain those managed marshes over the long term, continuous monitoring and management will also be required. The beneficial use of material dredged during the maintenance of the Calcasieu River and Pass (i.e., Ship Channel), the Sabine-Neches Waterway, and GIWW, should be used to rebuild eroded marshes (Figure 12). Restoration of sand dunes along the Gulf shoreline would also contribute to storm surge reduction and reduce inland surge-related wetland impacts. Specific restoration measures listed below are identified as either providing immediate storm surge protection benefits (I), or long-term, sustainable protection (S).

Calcasieu/Sabine Basin – Specific Wetland Restoration Recommendations

1. Shoreline erosion occurs throughout most of the Basin's Gulf of Mexico shoreline. To reduce this erosion problem, sand should be pumped onto or near the beach, as was recently completed under the CWPPRA program. Sand placement would also help to re-create an elevated beach rim and/or dunes which would dampen inland propagation of storm surges and waves. Vegetative plantings should also be included to help retain sand and promote dune formation. (I)
2. Operate a sediment bypass system at the Calcasieu Ship Channel to reduce Gulf shoreline erosion in the area west of the jetties. (I)
3. Create/restore marshes in and west of the Browns Lake area, in the northeastern portion of Sabine National Wildlife Refuge (NWR), in the East Cove Unit of Sabine NWR north of Cameron, and on private lands north of Sabine NWR and adjacent to Black Lake, using maintenance-dredged material from the Calcasieu Ship Channel. (I)
4. Construct one or more additional freshwater introduction structures to move GIWW freshwater, when available, southward into the Cameron Creole Watershed. (S)
5. Reforest cheniers to help attenuate storm surges and waves and provide vital neotropical migratory bird habitat. (S)

SUMMARY COMMENTS

The Service's major plan formulation concerns, recommendations and comments are provided below to guide future LACPR planning and decision-making.

1. Ensuring that long-term sustainability of significant portions of the coastal ecosystem, as well as the infrastructure and habitat it supports should be adopted as an over-arching goal of the LACPR project.

2. Proposed coastal wetland restoration features should be evaluated and selected based on their ability to restore the sustainability of the coastal ecosystem on a landscape level, especially within the more rapidly eroding Deltaic Plain. Otherwise, continued wetland loss and subsidence in that collapsing system will likely preclude achieving sustainable hurricane protection and may create a potentially false and dangerous sense of security to inhabitants that could lead to repeated catastrophic losses in the future.

3. Restoration of a sustainable coastal wetland ecosystem will require fundamental changes in the management of the Mississippi and Atchafalaya Rivers to divert, capture, and distribute their freshwater and sediment for the restoration of natural and sustainable landscape features to provide an outer defense against future storm surge events.

4. Non-structural means for reducing storm surge risks should be an integral part of any hurricane protection alternative implemented. Inclusion of non-structural measures that would have the effect as a matter of policy and practice, of increasing the damage-free coastal elevations would provide a more timely and cost-effective means of protection than would construction of a large continuous levee, especially in the Chenier Plain region.

5. Where levees are required to protect population centers and key infrastructure, a ring levee approach should be evaluated rather than a continuous levee across the coastal landscape. If the continuous levee approach results if further ecosystem process disruptions, it may cause more rapid and irreversible ecosystem collapse, thereby jeopardizing both the system's human and fish and wildlife uses.

The Service appreciates the opportunity to provide this Planning Aid Report to the Corps and involved State agencies. As required under the FWCA, we plan to provide additional alternative evaluation and select assistance, develop more specific wetland ecosystem restoration recommendation and comments targeted to move towards landscape sustainability, as well as assist the Corps in assessing project impacts and benefits according to the study schedule. In accordance with the National Partnership Agreement between the Department of the Army and the Department of the Interior, a proposal to facilitate our future involvement in LACPR development has been previously forwarded to the New Orleans District.

LITERATURE CITED

Louisiana Coastal Wetlands Conservation and Restoration Task Force and the Wetlands Conservation and Restoration Authority. 1998. Coast 2050: Toward a sustainable coastal Louisiana. Louisiana Department of Natural Resources. Baton Rouge, LA. pg 37.

National Research Council. 2006. Drawing Louisiana's new map: addressing land loss in coastal Louisiana. Committee on the restoration and protection of coastal Louisiana. National Academies Press, Washington, D.C. 189 pp.

Swarzenski, C. 2003. Surface-water hydrology of the Gulf intracoasal waterway in south-central Louisiana, 1996-99. U.S. Geological Survey Professional Paper 1672, prepared in cooperation with the U.S. Army Corps of Engineers, New Orleans District. 51pp.

U.S. Army Corps of Engineers. 2004. Louisiana coastal area (LCA), Louisiana ecosystem restoration study. U.S. Army Corps of Engineers, New Orleans District. Volume 1. Main Report. Nov. 2004.

APPENDIX A - Maps and Figures

An open-system Pontchartrain Basin hurricane protection levee alignment alternative

FWS-suggested modification of the Lake Pontchartrain Basin Barrier Plan levee alignment

Figure 1. Potential Lake Pontchartrain Basin hurricane protection levee alignments.

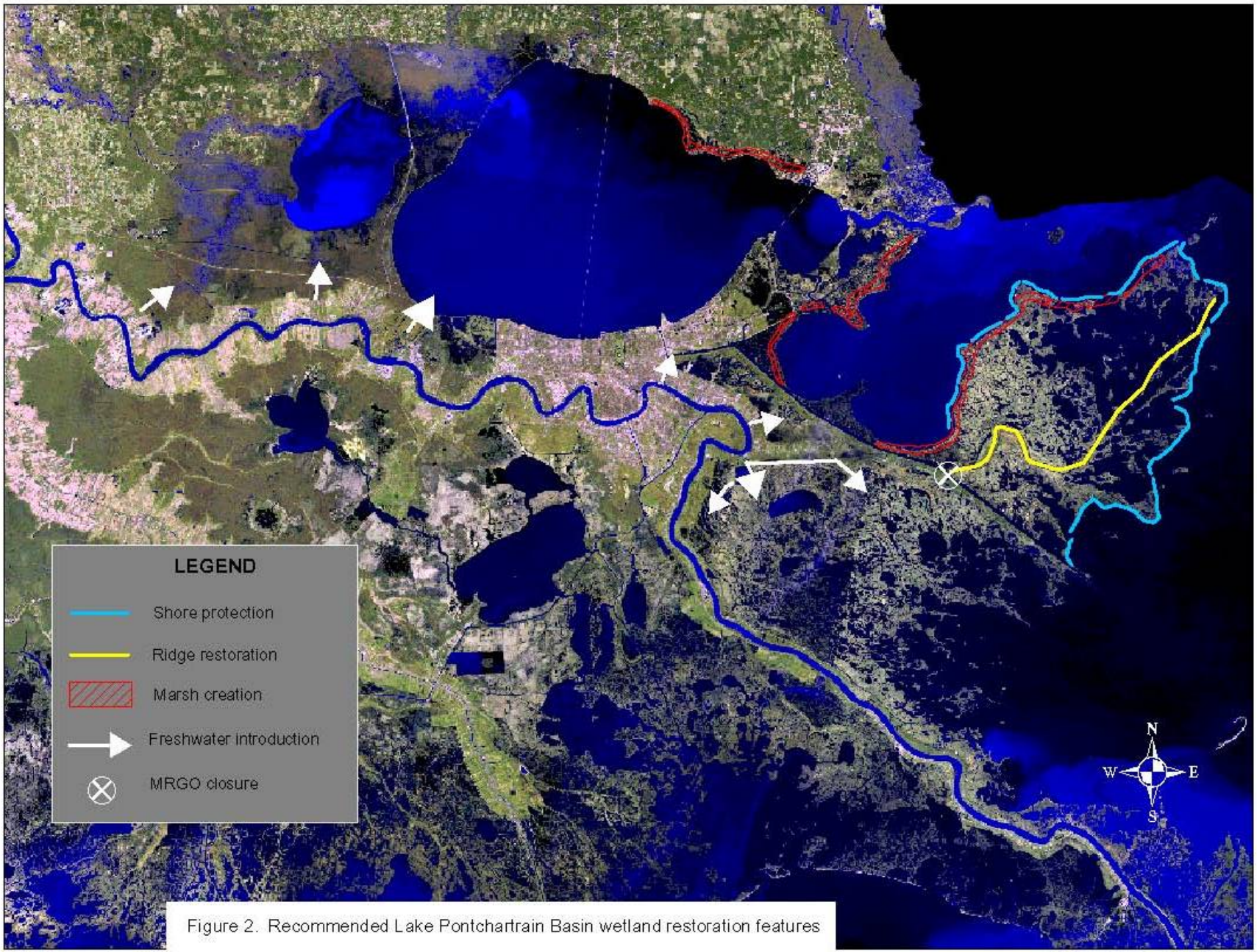


Figure 2. Recommended Lake Pontchartrain Basin wetland restoration features

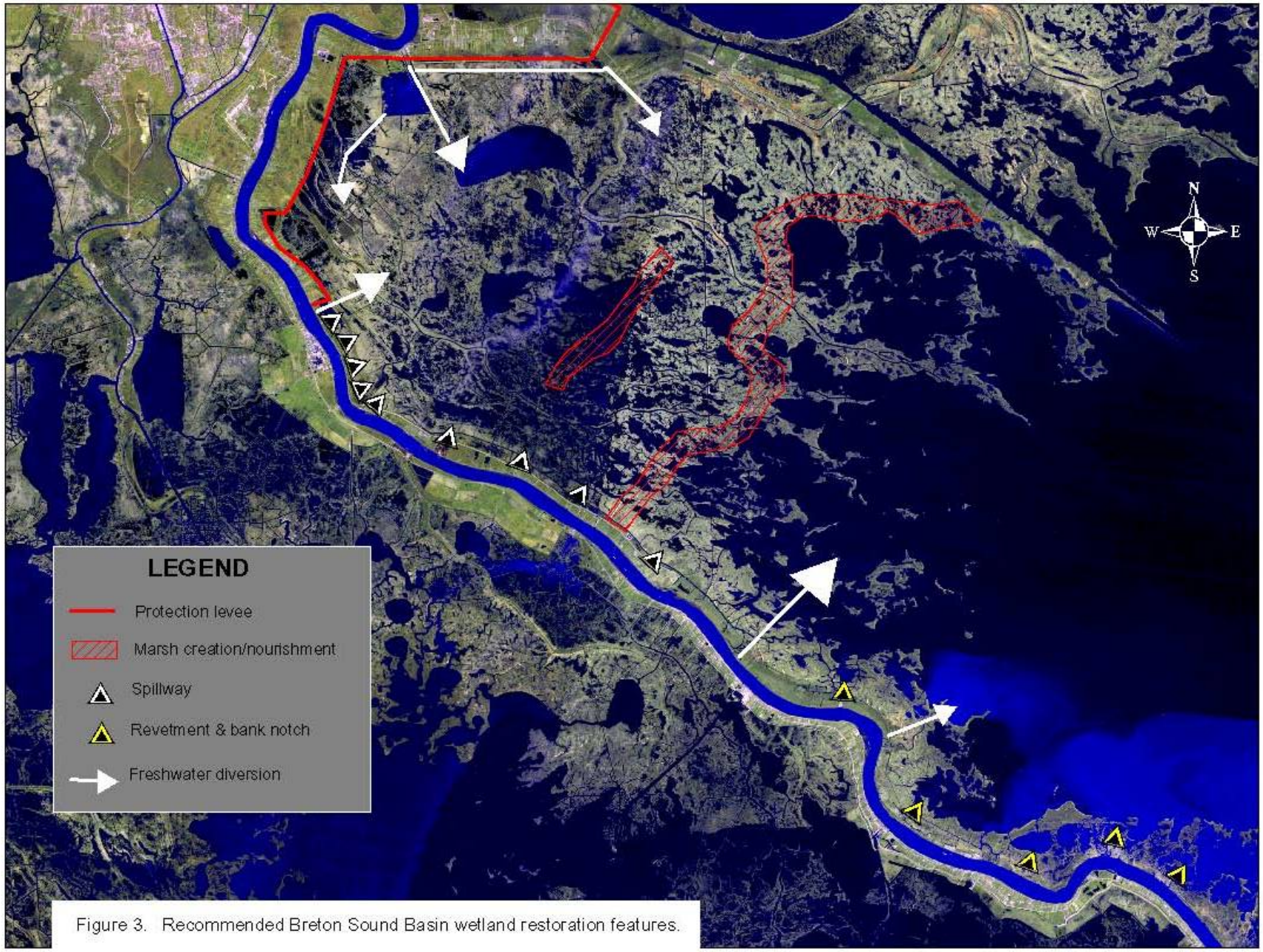


Figure 3. Recommended Breton Sound Basin wetland restoration features.

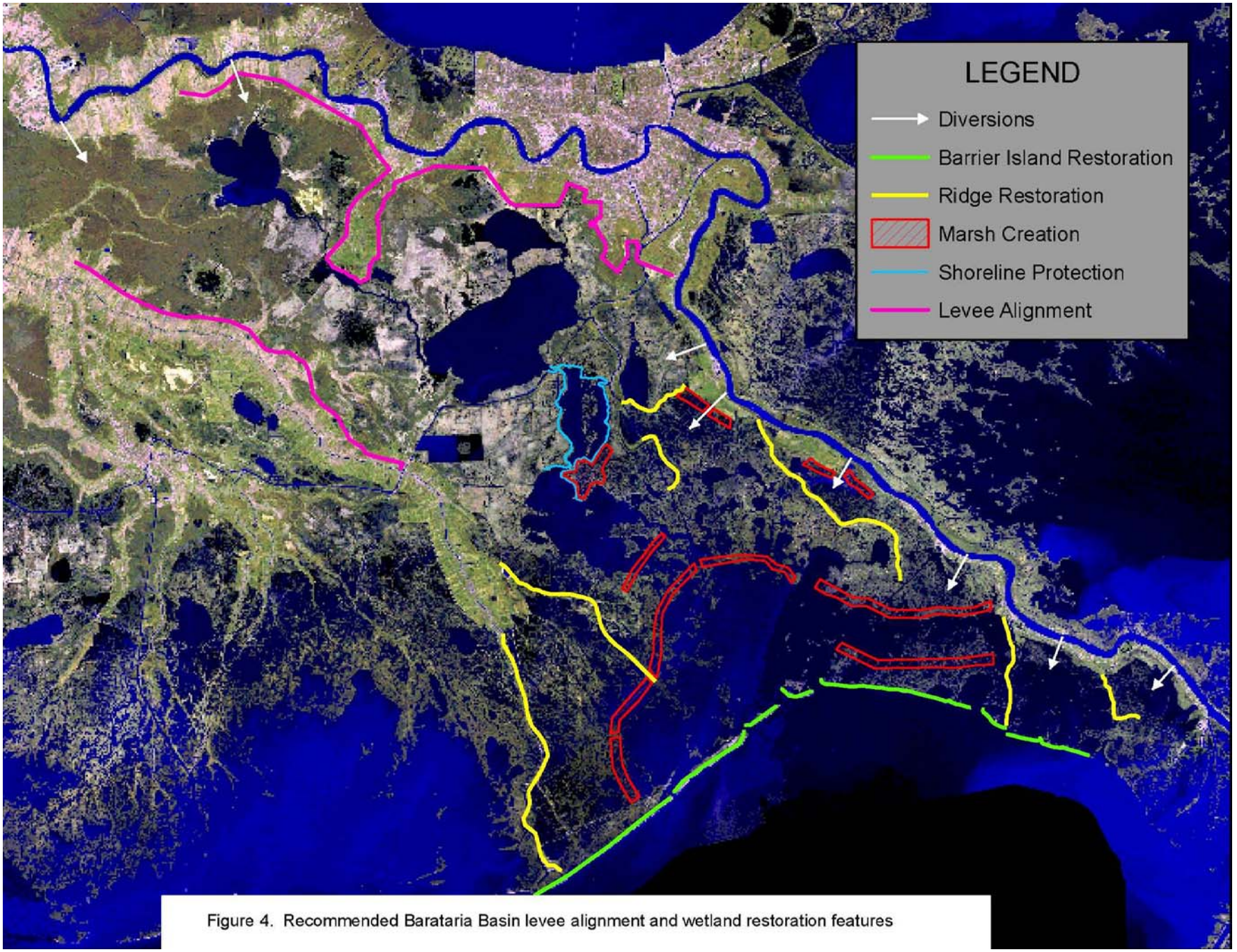


Figure 4. Recommended Barataria Basin levee alignment and wetland restoration features

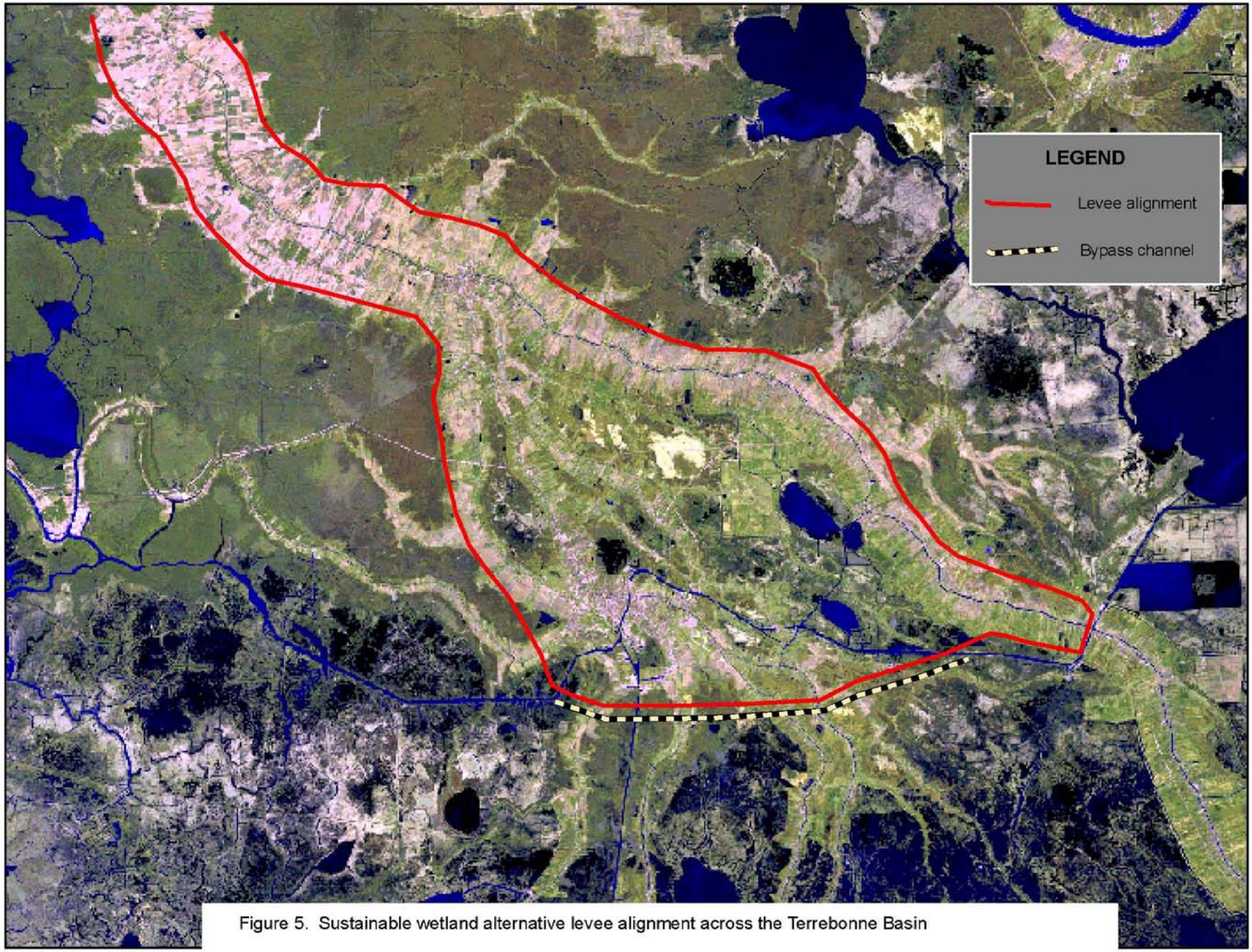
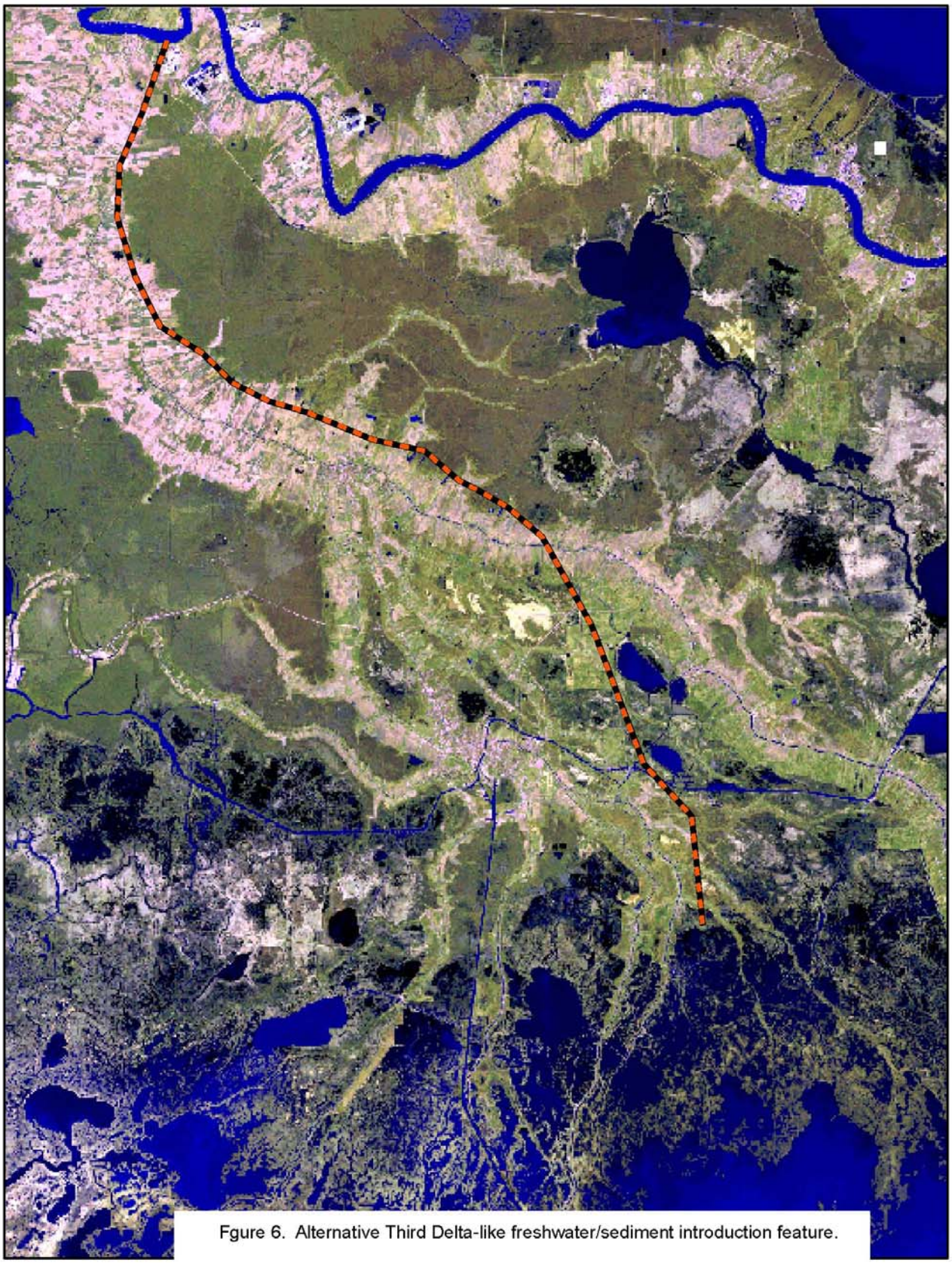


Figure 5. Sustainable wetland alternative levee alignment across the Terrebonne Basin



Fgure 6. Alternative Third Delta-like freshwater/sediment introduction feature.

Figure 7. FWS proposed Avoca Island Extension Levee breach and alternative breach location at Avoca Island.

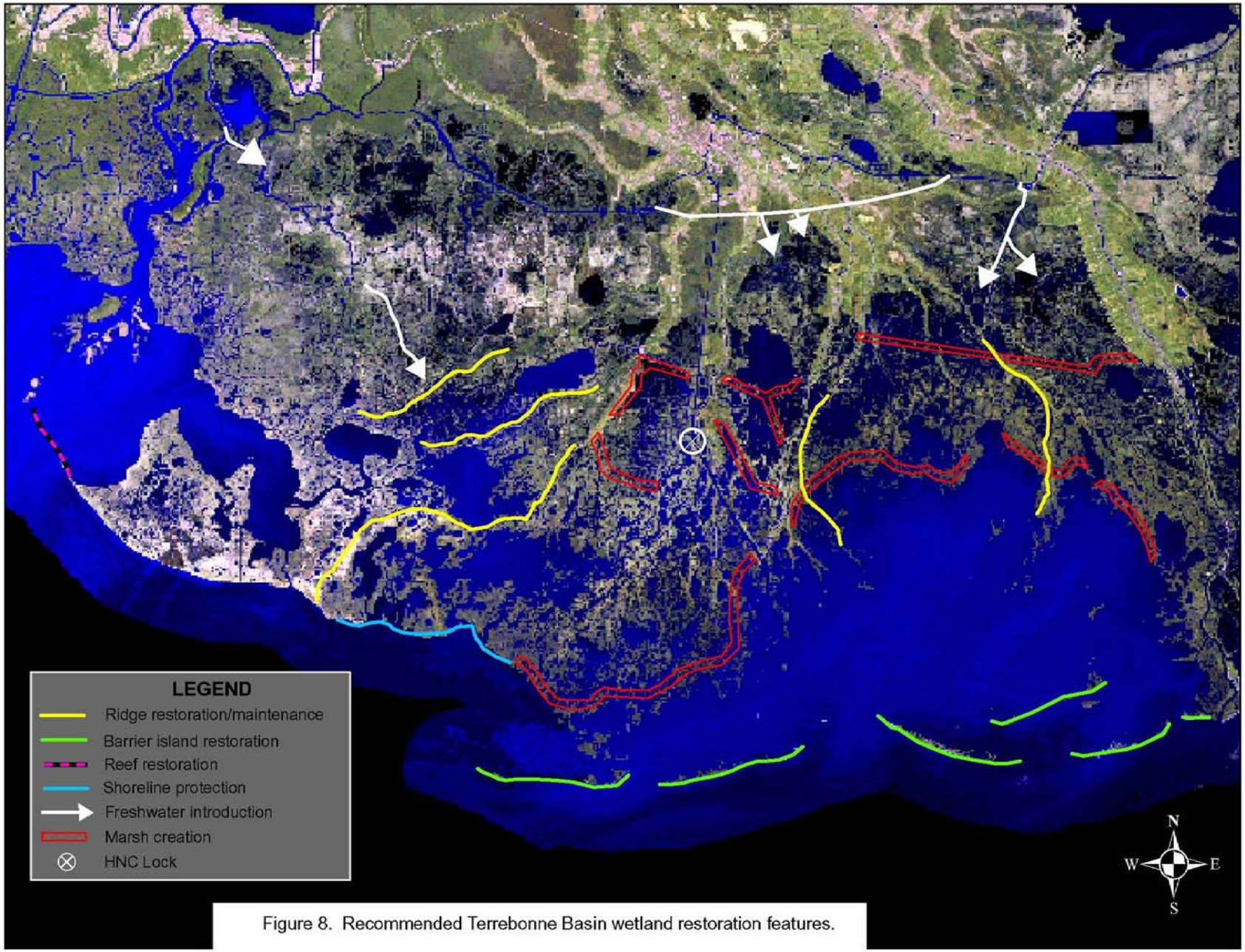
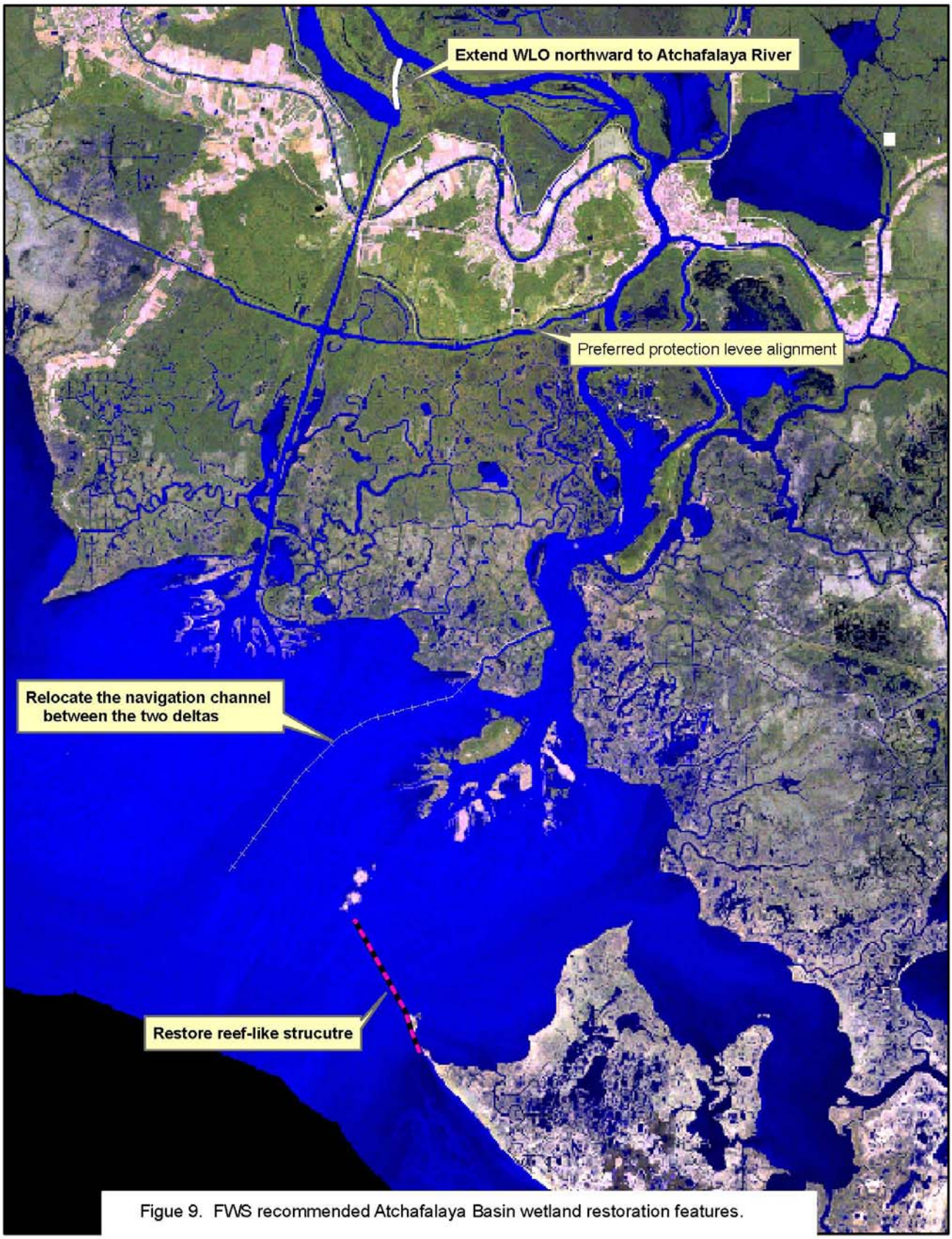


Figure 8. Recommended Terrebonne Basin wetland restoration features.



Figue 9. FWS recommended Atchafalaya Basin wetland restoration features.

Figure 10. FWS recommended Teche/Vermilion Basin wetland restoration features.

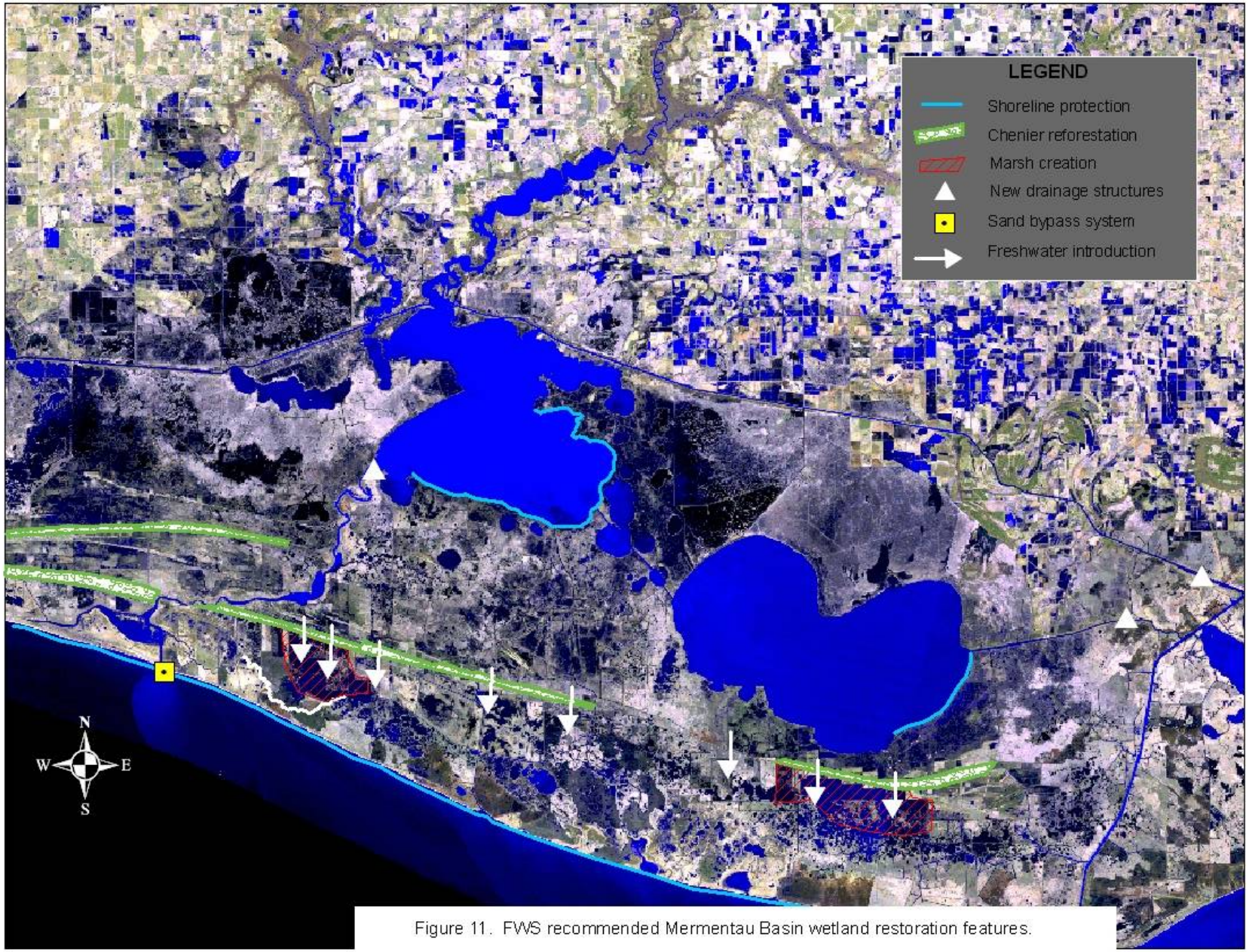


Figure 11. FWS recommended Mermentau Basin wetland restoration features.

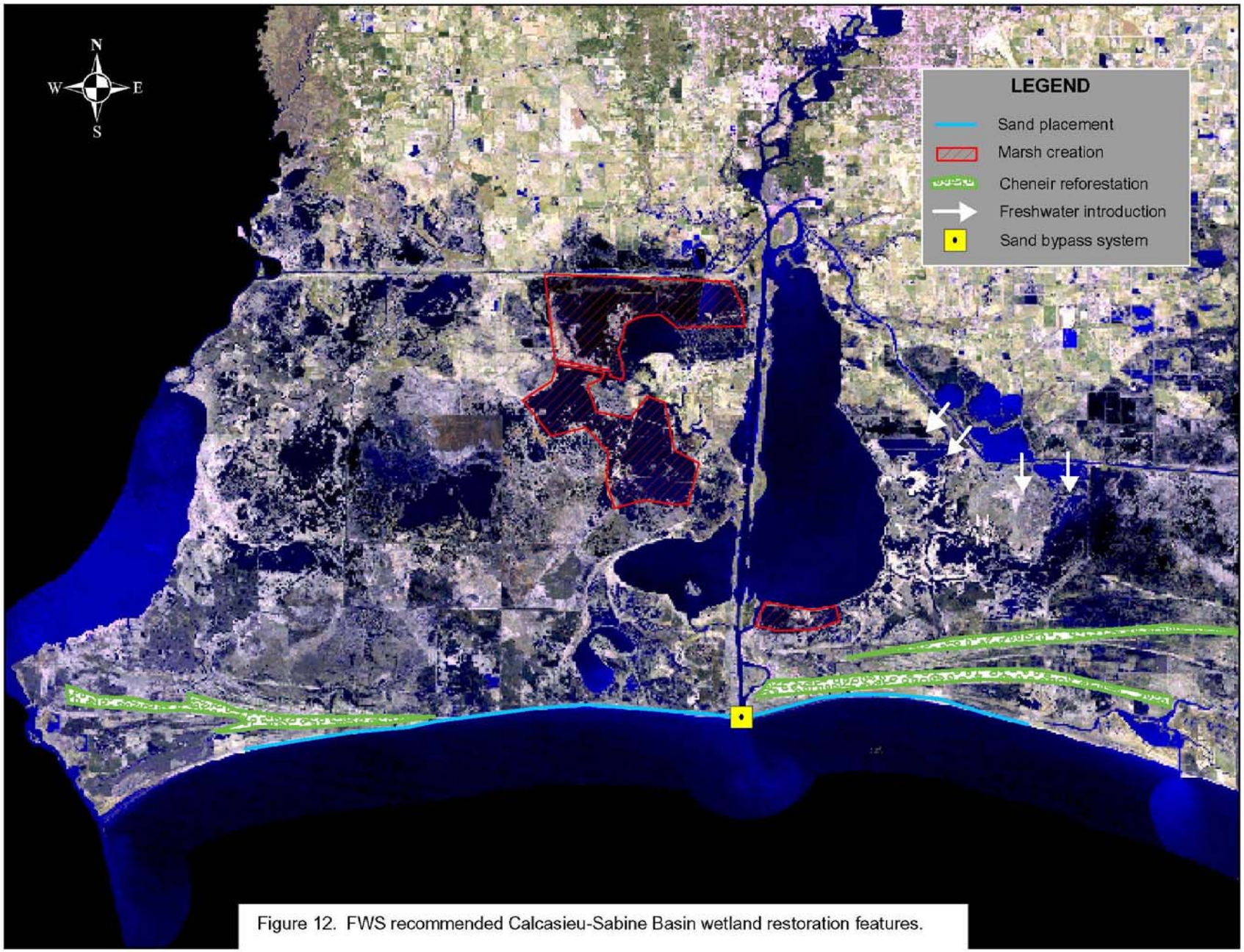


Figure 12. FWS recommended Calcasieu-Sabine Basin wetland restoration features.